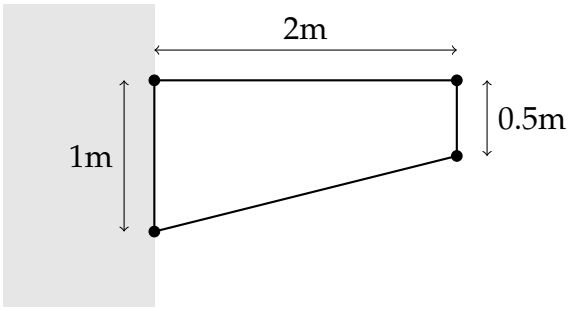
PX912 Solids Coursework Project

Consider the 2D geometry below, identical to that considered in Workshop 4:



Extend your Python script for a single element covered in Workshop 4 to multiple linear element calculations. You should address the problem with this geometry using the parameters and boundary conditions supplied to you individually by email.

In Workshop 5, you will be provided with a template notebook that will provide you with a meshing tool for this problem. You can use this to develop a code that can solve the problem with multiple elements, allowing you to:

- Evaluate nodal displacements;
- Evaluate strains and stresses at appropriate integration points; and
- Perform mesh refinements to assess mesh convergence.

Submission requirements

You should submit a Jupyter notebook containing your code and write-up (in accompanying markdown cells) via the Moodle portal here by **12pm on Wednesday 26 March**. As a minimum, your notebook should include:

- Plots showing the model geometry with boundary conditions;
- The problem you are solving in strong and weak form;
- Discussion of your findings, focussing on stress and strain; and
- An investigation of the discretisation error as a function of element size.

While you have plenty of time to complete the project, I encourage you to get most of the work done while PX912 is fresh in your mind!

Mark scheme

The broad expectations for this project are as follows:

- **High Distinction (80–100%):** As well as meeting the criteria for Disctinction below, the work is comprehensive, going beyond the original brief, exhibiting critical analysis of the work undertaken and a highly professional approach.
- **Distinction (70–79%):** The work demonstrates mastery of the methodologies and subject matter. Accuracy and presentation are both excellent, with only a few minor mistakes.
- **Merit (60–69%):** Conceptual understanding is solid, but analysis may contain minor flaws. The work is well-structured and organised, but may lack depth and breadth in places.
- **Pass (50–59%):** The work demonstrates a grasp of the subject matter, but there are areas of confusion. The work is fairly well structured, but may tend towards the factual rather than demonstrating deep understanding.
- **Fail (0–49%):** There are frequent misconceptions, and work is poorly organised. Conclusions are unreliable or unsubstantiated.

Extension ideas

There is **no expectation** that you go beyond the project brief to achieve a good mark, but for those wishing to hit really high marks, I will expect you to go significantly beyond the original problem. Some ideas for investigation include:

- Adding a body force to the problem;
- Considering a problem for a more complicated geometry; or
- Writing a comprehensive set of unit tests for your implementation.